

High p_T Hadron Suppression at RHIC

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Energetic partons propagating through matter lose energy via gluon bremsstrahlung (“jet quenching”), with the magnitude of the energy loss dependent on the energy density of the medium. Partonic energy loss has been proposed as a sensitive probe of the matter generated in high energy nuclear collisions at RHIC. The jet probes originate in the hard scattering of the constituents of the colliding nuclei. However, full reconstruction of jets in the environment of ultrarelativistic nuclear collisions is extremely challenging, and indirect jet-related observables must therefore be used.

Strong suppression of inclusive hadron yields at high transverse momentum (high p_T) has been observed in central Au+Au collisions for $p_T < 6$ GeV/c at $\sqrt{s_{NN}} = 130$ GeV [1]. These and related high p_T results have generated enormous interest because of their potential connection to jet quenching [2]. However, alternative explanations may also account for the existing data, including gluon saturation, jet attenuation in cold nuclear matter, and absorption of fragmentation hadrons [3]. Additional data are required to discriminate among these very different physics scenarios, and in particular to distinguish between initial state effects, such as gluon saturation, and partonic energy loss in the final state. Fig. 1 shows new high statistics measurements by the STAR collaboration of charged hadron p_T distributions for proton+proton and centrality selected Au+Au interactions at $\sqrt{s} = 200$ GeV.

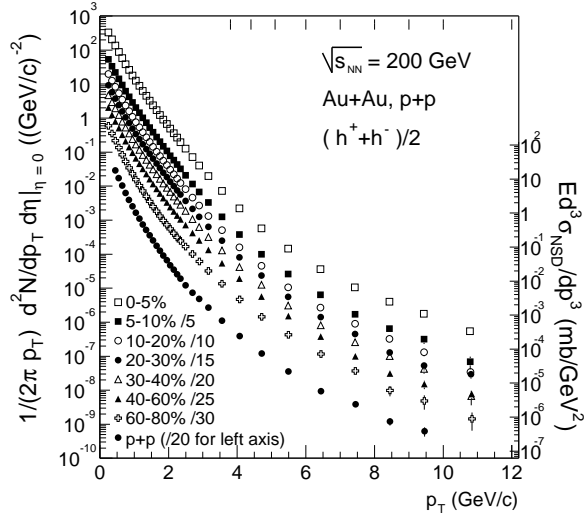


FIG. 1: Inclusive spectra.

The rate of small-cross section high p_T processes scales as N_{bin} , the number of binary collisions, if nuclear collisions are

an incoherent juxtaposition of individual nucleon-nucleon interactions. Fig. 2 shows the binary-scaled ratio of measured yields in central over peripheral Au+Au collisions, normalized such that unity indicates binary scaling. Large suppression at high p_T is seen for central collisions, with negligible p_T -dependence for $p_T > 5$ GeV/c. The expectations of two pQCD models and a saturation model calculation are shown, and are seen to agree (though for the saturation model only partially) with the data at high p_T . Models incorporating jet attenuation in cold matter or absorption of fragmentation hadrons can largely be excluded by the observed p_T dependence of the suppression. These data together with studies of d+Au collisions at RHIC will definitively measure both initial and final state effects on high p_T hadron production at RHIC, thereby isolating the effects of partonic energy loss.

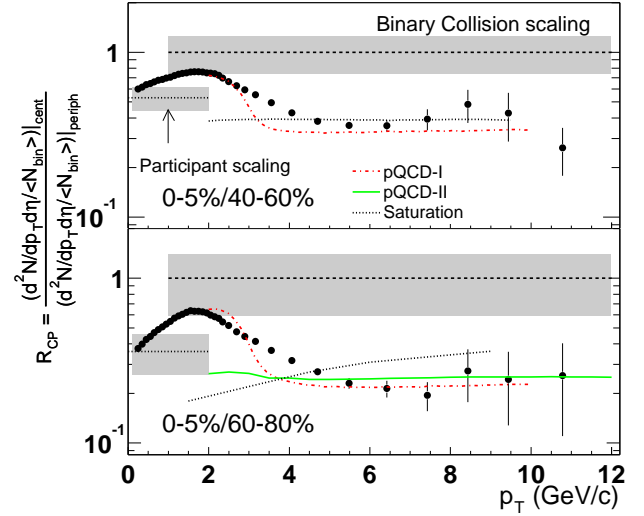


FIG. 2: Ratio of central/peripheral yields.

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